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Case Report

"The stony heart": perioperative management of severe mitral annular calcification and porcelain left atrium in a patient requiring prolonged cardiopulmonary bypass

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ABSTRACT

Mitral annular calcification (MAC) presents a formidable challenge in cardiac surgery, often transforming routine valve replacement into a complex reconstruction. When combined with a "porcelain" left atrium, the risks of atrioventricular disruption and inability to expose the valve increase exponentially. Herein this case report presents the case of a 56-year-old female with rheumatic heart disease and a "porcelain" left atrium who underwent mitral valve replacement (MVR). Preoperative multidisciplinary discussion, including consultation with visiting US cardiothoracic faculty, established a consensus to "respect the calcium" rather than perform radical debridement, prioritizing atrioventricular integrity over annular geometry. The intraoperative course was complicated by a rigid, calcified annulus resulting in significant paravalvular leak (PVL). This necessitated two surgical revisions and a total cardiopulmonary bypass time of 367 minutes. Following a managed recovery strategy, the patient was extubated on postoperative day 2 and discharged home on day 7. Severe MAC with a porcelain atrium represents a "double jeopardy" scenario. Successful management requires a multidisciplinary "respect the calcium" strategy and the mandatory use of intraoperative transesophageal echocardiography (TOE). This case demonstrates that prolonged bypass time is a justifiable investment to ensure a competent valve and that aggressive ICU management can mitigate the physiological insult of extended surgery.

Keywords: Mitral annular calcification, Porcelain atrium, Mitral valve replacement, Paravalvular leak, Prolonged cardiopulmonary bypass

INTRODUCTION

Mitral annular calcification (MAC) is a chronic degenerative process characterized by calcium deposition in the fibrous ring of the mitral valve.[1] In severe cases, it transforms mitral valve replacement (MVR) from a routine procedure into a high-risk reconstruction associated with atrioventricular (AV) groove rupture, circumflex artery injury, and paravalvular leak (PVL).[2] The surgical challenge is compounded when MAC coexists with a "porcelain left atrium"—diffuse calcification of the atrial wall. This condition severely limits surgical exposure and increases the risk of catastrophic atrial tearing during retraction. Management strategies generally fall into two categories: "resect" (radical debridement and reconstruction) or "respect" (conservative management avoiding calcium removal). We present a case of severe MAC and porcelain atrium managed via a consensus-based "respect" strategy, illustrating the intraoperative decision-making required to manage recurrent PVL during a prolonged pump run.

CASE REPORT

A 56-year-old female (BMI 25 kg/m²) presented with dyspnea (NYHA class II) and a history of atrial fibrillation. preoperative multislice computed tomography (MSCT) revealed a "porcelain left atrial wall" and heavy mitral

annular calcification (calcium score 2.1). Transthoracic echocardiogram (TTE) confirmed severe mitral regurgitation and moderate-to-severe stenosis (mitral valve area=0.98 cm^2).

Preoperative planning

Given the high-risk anatomy, the case was discussed in a multidisciplinary forum involving visiting cardiothoracic surgeons from the United States. The consensus was to adopt a "respect the calcium" strategy. Radical decalcification was deemed too hazardous due to the risk of AV groove disruption. The surgical plan focused on minimal atrial manipulation and conservative suture placement.

Surgical management

A standard median sternotomy was performed. Upon entering the left atrium, the "porcelain" nature of the atrial wall was confirmed, characterized by extensive yellowish calcific plaques within the myocardium (Figure 1).

Figure 1: Intraoperative view of the 'porcelain' atrial wall showing extensive yellowish calcific plaques within the myocardium.

Gentle, graded retraction was utilized to prevent atrial fragmentation, providing only a "keyhole" view of the mitral valve (Figure 2). A 25 mm mechanical prosthesis was seated using pledgeted sutures. Following the release of the aortic cross-clamp, intraoperative Transesophageal echocardiography (TOE) revealed a significant anterior PVL at the A1 position. The leak was attributed to a focal calcium spicule preventing the sewing ring from seating flush.

Revision and outcome

The cross-clamp was reapplied, and the leak was repaired with reinforcing sutures. A subsequent leak test revealed persistence of the jet, necessitating a third cross-clamp application for aggressive reinforcement. Final TOE confirmed a competent seal.

The total cardiopulmonary bypass (CPB) time was 367 minutes, with a cross-clamp time of 297 minutes. The patient was transferred to the ICU with moderate inotropic support. A conservative weaning strategy was employed to manage the physiological impact of prolonged CPB ("pump lung" and coagulopathy). The patient was extubated on postoperative day 2, inotropes were weaned by day 1, and she was discharged home on postoperative day 7 in stable condition.

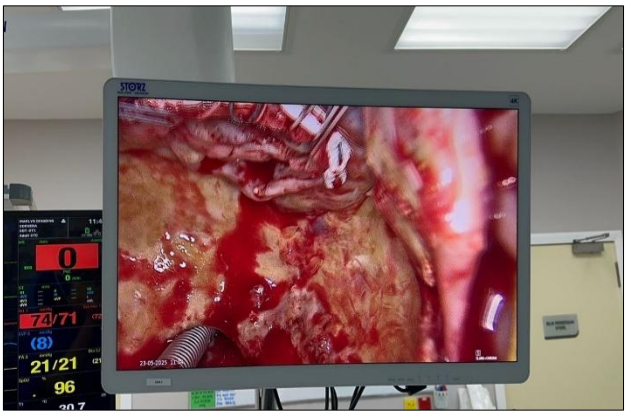

Figure 2: Restricted surgical view of the mitral valve apparatus due to the rigid, calcified atrial wall.

DISCUSSION

The "double jeopardy" of porcelain atrium and mac the coexistence of severe mitral annular calcification (mac) and a "porcelain left atrium" represents a surgical "double jeopardy." While MAC alone is a well-documented challenge, the addition of a calcified atrial wall creates a unique and hazardous environment. The calcification leads to a loss of atrial compliance, turning the left atrium into a rigid chamber that resists retraction. This severely restricts surgical exposure, forcing the surgeon to operate through a "keyhole" rather than a standard wide field.

As demonstrated in this case, excessive force during retraction carries a high risk of atrial wall fragmentation or extension of the atriotomy into the pulmonary veins—a complication that is often unrepairable.[3] The successful exposure in this case relied on "micro-adjustments" of the retractor and a conscious decision to accept limited visibility to preserve atrial integrity.

Strategic decision making

"Resect" versus "respect" The management of severe MAC remains a polarized debate in cardiac surgery, often categorized into "resect" versus "respect" strategies. The "resect" approach: radical debridement of the calcium bar followed by annular reconstruction (e.g., the "commando" procedure) offers the advantage of restoring annular geometry and allowing for a larger prosthesis. However, this technique is associated with a 10-15% operative

mortality rate, primarily due to atrioventricular (AV) groove rupture and intractable hemorrhage.[4]

The "respect" approach: the consensus reached with the visiting US faculty prioritized patient survival over anatomical perfection. By choosing to "respect the calcium," we avoided the catastrophic risk of AV rupture. However, this strategy inherently accepts a higher risk of paravalvular leak (PVL), as the rigid, irregular calcium deposits prevent the sewing ring from conforming to the annulus. This case validates the "respect" strategy: while the patient required multiple revisions for leaks, she survived. Had an AV rupture occurred during attempted debridement, the outcome would likely have been fatal on the table.

Paravalvular leak: the mechanics of failure and repair paravalvular leak is the Achilles' heel of the "respect" strategy. In this case, the recurrent anterior PVL at the A1 position illustrates the mechanical mechanism of failure: calcium spicules act as fulcrums, lifting the prosthetic sewing ring off the tissue and creating gaps.

The management of this intraoperative complication required aggressive decision-making. Leaving the operating theater with a moderate PVL in a MAC patient is not a viable option; the high-velocity regurgitant jet causes severe mechanical hemolysis and inevitably leads to heart failure.[5] The decision to re-cross clamp twice—despite the cumulative bypass time—was the critical determinant of long-term success. It highlights a key lesson: the physiological insult of prolonged bypass is recoverable, but a significant paravalvular leak is often a terminal event in this patient population.

Physiological resilience and ICU management A cardiopulmonary bypass time of 367 minutes is classified as "extreme" and is typically associated with severe coagulopathy, vasoplegia, and systemic inflammatory response syndrome (SIRS). The patient's ability to be extubated on postoperative day 2 suggests two critical factors: myocardial protection-despite the calcified root and prolonged arrest time (297 minutes), effective cardioplegia delivery preserved biventricular function, preventing low cardiac output syndrome (LCOS) and targeted hemostasis. The use of rotational thromboelastometry (ROTEM) allowed for precise, goal-directed transfusion of fibrinogen and platelets. This mitigated the "pump lung" and inflammatory coagulopathy often seen after extended extracorporeal circulation, facilitating a safe, albeit delayed, extubation.

CONCLUSION

Severe MAC with a porcelain atrium requires a tailored surgical approach. The "respect the calcium" strategy offers a safety margin against fatal rupture but demands vigilance for paravalvular leaks. Intraoperative TOE is mandatory, and surgeons must be willing to revise the repair immediately, even at the cost of prolonged bypass time.

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